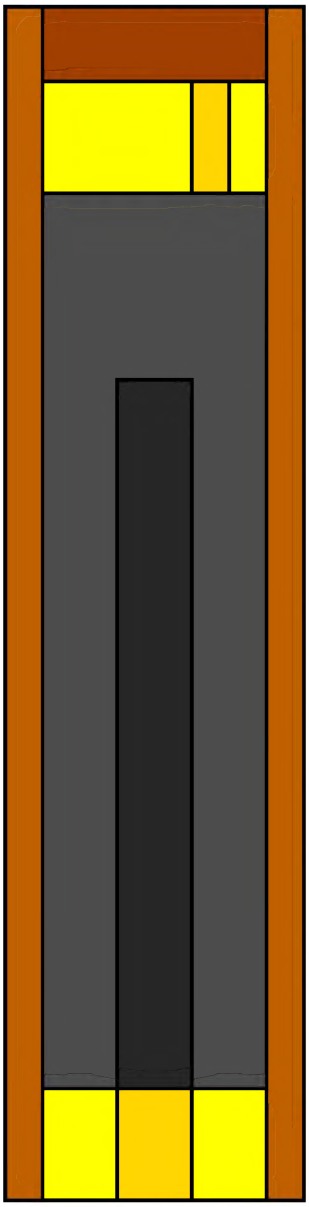
A Reliable BP Rocket

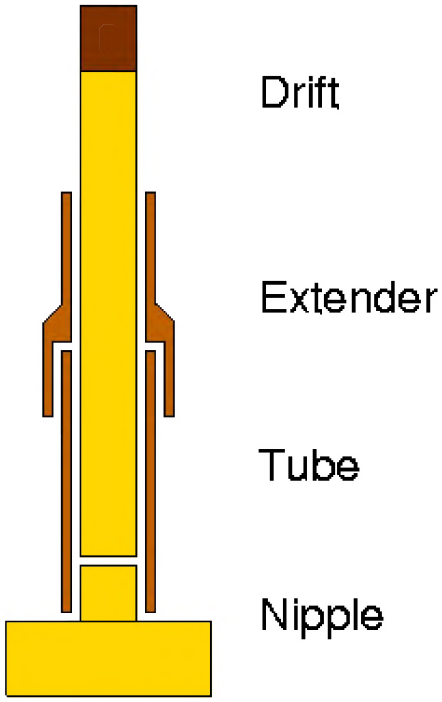
2003-12-21



This is my most successful rocket motor design. Based around a 9.5 mm ID (3/8") tube, only 50 mm (2") in length with a black powder variant propellant. It gives a short but powerful burn, capable of lifting 50 g payloads to respectable heights.

It is a fairly classic core-burning design, optimized for rapid assembly rather than excellent performance. It still manages quite respectable performance despite having a very primitive nozzle just drilled through the clay end plug.

The tooling is very simple, only a nipple, rammer and case extender are required. You can do without the nipple and case extender, but they speed assembly and make the whole experience much less frustrating. You can roll your own tubes, but Skylighter's TU1013 tube is perfect for the job and saves much time.



The propellant is prepared by ball milling all the chemicals, except the Aluminium, together for about 2 hours. After which the Aluminium is screened in using a 60 mesh screen. The composition is moistened with a 25% solution of Alcohol, kneaded, and forced through a 20 mesh screen to granulate it. The moist granules are allowed to dry on a sheet of paper then screened through a coarse screen to break up any lumps.

The granulation makes loading the composition into the motors much easier and also makes the propellant somewhat more powerful. It is not really required, you can ram the meal straight out of the mill if you wish. In fact I made the first batch of RP using only a mortar and pestle. It provided quite acceptable performance, but the milled and granulated propellant is definitely worth the extra effort.

The nozzle and bulkhead plug are pulverized cat litter. I treat my cat litter with 5-10% tea-light candle wax to reduce crumbling. The wax is dissolved in petroleum spirit (shellite, naphtha, etc) and distributed throughout the clay, then the solvent is left to evaporate. The clay is also granulated slightly to simplify loading. This whole clay treatment process is also not 100% required, but helps as the passfire to the payload and the core are drilled out rather than formed with a mandrel while ramming (drilling tends to break up the surface of dry cat litter - but the damage is largely cosmetic).

I ram the rockets bulkhead first. The nipple forming a small recess in the top of the casing which is useful when coupling the motor to payloads. I have a special scoop which measures the clay and propellant increments. The bulkhead and nozzle each take one scoop of granulated clay. The propellant grain takes four scoops, each rammed solidly in place before the next is added. The last two scoops of propellant and clay are much easier to load when using a case extender.

Once the casing is charged a 2 mm drill is used to drill the passfire hole in the bulkhead. The passfire is drilled off-center to offer better timing, but it is still activated almost immediately after motor burn-out, the payload should include a suitable delay of its own (if required). The nozzle and core are then drilled out using a 3 mm drill. The core extends 7/10s of the length of the propellant grain. You can reduce this if you want a longer, more gentle burn, or if you experience motor catos. Note here that we are drilling into Aluminium containing propellant, which is potentially dangerous! As long as you go gently and clear the drill often it should not present any problems. A drill press is optimal for getting the core and nozzle nice and straight, but you can do it quite easily with a hand drill and some care.

Your completed rocket should look something like this (here with a canister shell payload):

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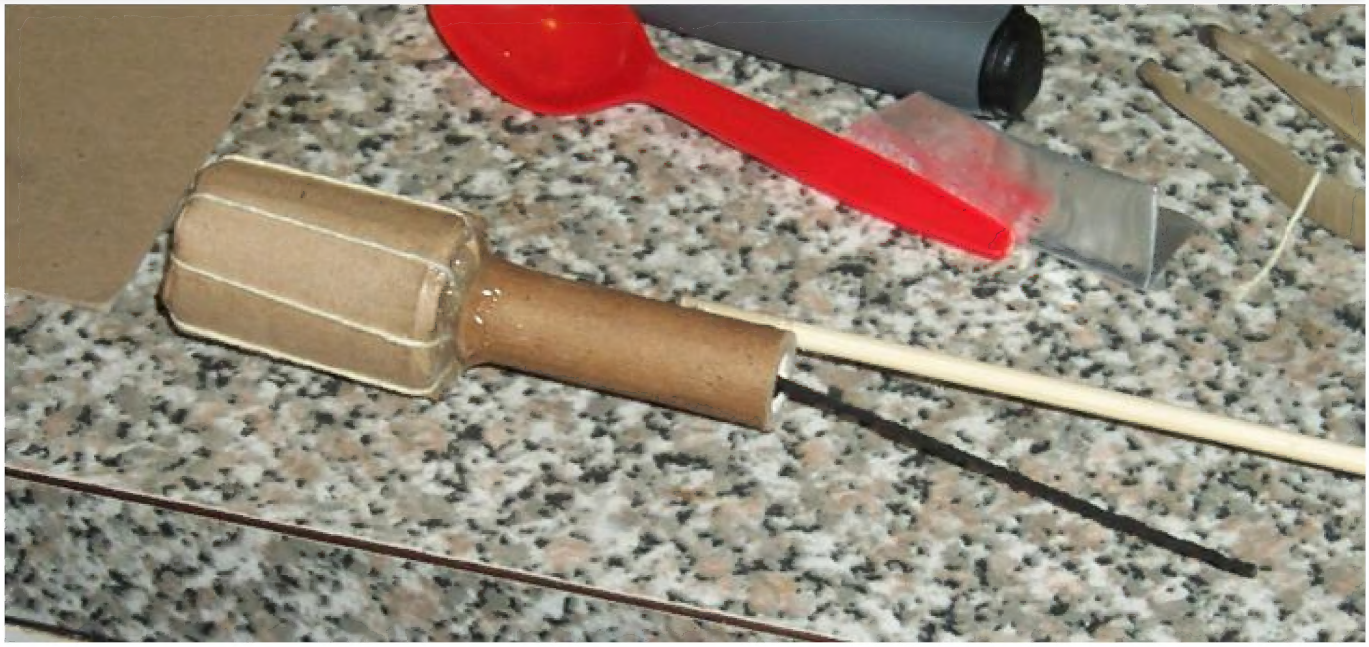

Feel free to make up your own tooling with a cored mandrel and hollow drift, especially if you want to use more dangerous or expensive propellants (drilling out the core wastes a significant amount of propellant and the clay contaminated swarf is basically useless). This motor is my work-horse device, so its expedient assembly was the main design requirement. You may wish to optimize the nozzle geometry if you are looking to squeeze the last few percent out of the device.

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